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Summary of Opacity and Gas CEMS (Continuous Emission Monitoring System) Audit Programs

Engineering-Science, Fairfax, VA

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16. ABSTRACT

The U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Stationary Source Compliance Division, as well as the Emission Monitoring Science Laboratory, Quality Assurance Division, and several regional offices have sponsored continuous emission monitoring system (CEMS) performance audits to determine the precision and accuracy of CEMS and to develop and evaluate the audit techniques. Opacity, SO_2 and NO_x CEMS at a variety of industrial sources (electric utilities, manufacturing facilities, petrochemical processes, kraft pulp mills, etc.) were audited using NBS traceable filters, EPA reference methods, and calibration gases are reference standards. This report provides a summary of the results of these audits. The results demonstrate:

- o 80% of the opacity monitors audited met calibration error criteria (5% error) for low- and mid-range references values*; 65% of the monitors met these criteria for high range reference values.
- o 80% of the gas CEMS met the calibration error criteria (5% error).
- o 80% of the gas CEMS met the relative accuracy criteria (25% relative accuracy).

* 65% for hi-range reference values.

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Washington, D.C. 20460

September 1984

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ABSTRACT

The U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Stationary Source Compliance Division, as well as the Emission Monitoring Science Laboratory, Quality Assurance Division, and several regional offices have sponsored continuous emission monitoring system (CEMS) performance audits to determine the precision and accuracy of CEMS and to develop and evaluate the audit techniques. Opacity, SO_2 and NO_x CEMS at a variety of industrial sources (electric utilities, manufacturing facilities, petrochemical processes, kraft pulp mills, etc.) were audited using NBS traceable filters, EPA reference methods, and calibration gases are reference standards. This report provides a summary of the results of these audits. The results demonstrate:

- 80% of the opacity monitors audited met calibration error criteria (5% error) for low- and mid-range references values*; 65% of the monitors met these criteria for high range reference values.
- 80% of the gas CEMS met the calibration error criteria (5% error).
- 80% of the gas CEMS met the relative accuracy criteria (25% relative accuracy).

* 65% for hi-range reference values.

SUMMARY OF OPACITY AND GAS CEMS AUDIT PROGRAMS

PURPOSE

Since promulgation of state and federal requirements for installation and operation of continuous emission monitoring systems (CEMS) the facilities affected by these requirements have experienced varying degrees of success in achieving and maintaining reliablity and accuracy for these systems. The Environmental Protection Agency (EPA) regional offices and the Stationary Source Compliance Division (SSCD) have sponsored CEM auditing programs for both opacity and gaseous CEMS (NO_x and SO_2) to determine the accuracy, calibration, and operating status of the CEMS audited. The Emission Monitoring and Sampling Laboratory (EMSL) sponsored the development of these audit procedures and many audits summarized in this report were conducted during this development process. The purpose of this report is to provide a summary of the results of these audits for agency personnel responsible for assessing the quality assurance (QA) of CEMS data and/or using CEMS excess emission reports in a compliance program. This information may be used to compare the performance (reliability, accuracy, etc.) of a single CEMS to the experience of a larger population as characterized by the summary of audit results.

BACKGROUND

The SSCD, the Environmental Monitoring Systems Laboratory (EMSL) and many EPA regional offices have conducted performance audits of CEMS measuring the opacity of particulate emissions and the emission rate of gaseous SO_2 and NO_x emissions from stationary sources of air pollution. Facilities subject to NSPS, SIP, and PSD monitoring requirements, and representing several major source categories have been audited. The opacity CEMS audit procedures used conform to those defined in the EPA publication entitled "Performance Audit Procedures for Opacity Monitors" (EPA 340/1-83-010, January 1983). Gas CEMS were audited using two procedures: calibration gas audits which determine accuracy and the precision of a CEMS relative to calibration gases; and, relative accuracy audits which determine the accuracy of a CEMS relative to measurements by EPA Methods 6 (SO_2) or 7 (NO_x).

The audits were conducted in some cases to determine the quality of emission measurements made by the CEMS and determine the reliability of CEMS to properly indicate excess emissions. In some cases, regional offices requested audits to verify data validity when previous excess emission reports indicated significant occurrences of CEMS malfunctions or excess emissions. Many CEMS were audited because several years had passed since a performance specification test (PST), the only demonstration of

CEMS data quality assurance required by NSPS regulation, and by most SIPs, other than daily drift checks. Other audits were conducted as part of an EMSL sponsored project to develop audit procedures, and still others were conducted as part of state agency CEM training programs.

The audits were conducted by Engineering-Science (ES) and Entropy Environmentalists usually with participation of regional, state, or local agency personnel who were present to be trained in audit procedures. Recently all EPA regional air compliance branches, and several state agencies have received opacity CEMS audit equipment, and some of these organizations have begun conducting performance audits.

OPACITY CEMS

The opacity CEMS audit procedures evaluate the operating status and the performance of each system. The operating status is determined by inspection of fault indicators for malfunctions, optical surfaces for dirt, and when possible, internal constants such as path length correction factor, and calibration value. The performance evaluation verifies the CEMS response to NBS traceable standards (optical filters) to assess the linearity, precision, and accuracy of the instruments when tested against calibration filters. This procedure uses an optical device to simulate a clear stack or zero opacity condition. The criteria used to evaluate performance results are the calibration error and zero compensation limits (3% and 4% opacity, respectively) found in 40 CFR 60, Appendix B, PS1. In most cases where review of the operating status indicated problems, the monitor also failed to meet the performance criteria. In many of the cases, the problems were easily correctable.

Calibration Error Audit Results

The results of the calibration error performance audits for opacity and gas CEMS are presented in Table 1. Table 3 lists the facilities at which opacity CEMS were audited. The results indicate that approximately 80% of the opacity CEMS meet the PS1 calibration error limits for both the low and mid-range tests and 65% of the opacity CEMS meet the high-range limit.

GAS CEMS

Gas CEMS Calibration Error Audit Results

The gas (NO_x and SO_2) CEMS audited for calibration error, a performance evaluation procedure, were evaluated for linearity, precision, and accuracy by comparing the CEMS response to known values of NBS traceable gases injected into the CEMS analyzer. Only analyzers capable of receiving audit gases were audited. Of the gas CEMS audited for calibration error, 80% met the 15% control limit stated in the recent proposal of Appendix F, Procedure 1 (FR, Vol. 44, No. 51, March 14, 1984, pp. 9678-9682). Table 2 summarizes the results of these audits and Table 4 lists the facilities at which audits were conducted. It should be noted that there are currently no promulgated requirements for calibration error testing.

Relative Accuracy Audit Results

To date, 45 performance audits of 25 SO_2 CEM systems installed on electric utility and industrial boilers at 20 companies have been conducted; some of the SO_2 CEMS were audited several times. All of the SO_2 CEMS are installed on coal-fired boilers, except for three: two are installed on industrial boilers firing combinations of coal and refuse and one is installed on a recovery boiler. Seven of the SO_2 CEMS audited were installed on coal-fired boilers equipped with wet FGDs.

In addition, 21 performance audits of eight NO_x CEMS installed on electric utility and industrial boilers at seven companies have been conducted. It is noted that two of the NO_x CEMS are installed on oil-fired boilers. Two of the NO_x CEMS are installed on units equipped with wet FGD systems. Table 5 lists the facilities with CEMS which were audited for relative accuracy.

All of the SO_2 and NO_x CEMS relative accuracy performance audits were conducted for monitors which had previously satisfied PST requirements. It should be noted that most of the performance audits were announced well in advance of the testing. In some cases source personnel and/or monitor manufacturer representatives are known to have inspected and/or made adjustments to the subject CEMS immediately prior to the audit.

Overall, the gas CEM performance audits provided the following results, which are also presented in Table 6 (SO_2) and 7 (NO_x):

SO_2 CEMS

- The 25 installed SO_2 CEMS met the applicable relative accuracy specification for 38 of the 45 audits conducted (six of the nine relative accuracy test failures were consecutive tests of the same monitoring system).

- Twenty of the 25 SO_2 CEMS audited met the performance criteria for each of the relative accuracy tests which they were subjected to.

NO_x CEMS

- The eight installed NO_x CEMS met the applicable realtive accuracy specification for 15 of the 21 audits conducted (two of the six relative accuracy test failures were consecutive tests of the same monitoring system).

- Three of the eight NO_x CEMS audited met the accuracy specifications for all of the relative accuracy tests which were conducted.

In evaluating the above results, it is important to note that: (1) there are no federally promulgated quality assurance requirements applicable to the audited CEMS, and (2) there are not promulgated requirements for the CEM operators to periodically test installed CEMS or to take necessary corrective actions where unacceptable performance is observed.

CONCLUSIONS

Based upon a comparison of a August 1983 version (93 monitor audits) of Table 1, and the current updated version (213 monitor audits), the Performance Audit Results indicate a slight increase in the percentage of monitors which did not meet the performance audit specifications as listed below. One may conclude, however, that a large majority of the opacity CEMS audited satisfied the performance audit criteria.

	% Monitors Out of Specification	
Performance Audit Parameter	August 1983 Summary	September 1984 Summary
Monitor Alignment	3	4
Internal Span Error	19	22
Internal Zero Error	6	6
Zero Compensation Factor	15	22
Calibration Error: Low-Range	11	15
Calibration Error: Mid-Range	17	22
Calibration Error: High-Range	25	35

No summary of calibration gas or relative accuracy audits has been previously prepared for general distribution within EPA and no comparison to previous results can be made. As with opacity CEMS, the results of the gas CEMS audit program indicate that the majority of the CEMS audited met the audit criteria.

TABLE 1

OPACITY MONITOR AUDIT RESULTS

Audit Analyses	Lear Siegler		Contraves Goerz		Dynatron		Esterline Angus		% Total No. Monitors Tested Out of Specs.
	Number Within Specs.[c]	Number(%) Out of Specs.[c]	Number Within Specs.[c]	Number(%) Out of Specs.[c]	Number Within Specs.[c]	Number(%) Out of Specs.[c]	Number Within Specs.[c]	Number(%) Out of Specs.[c]	
Number of Monitors Audited	139		48		28		3		
PERFORMANCE AUDIT RESULTS									
Monitor Alignment	129	4 (3%)	47	0 (0%)	22	3 (11%)	2	1 (50%)	4
Internal Span Error	97	26 (19%)	28[b]	12 (25%)	21	6 (21%)	3	0 (0%)	22[b]
Internal Zero Error	116	8 (6%)	45	3 (6%)	26	1 (4%)	3	0 (0%)	6
Zero Compensation Factor	105	23 (17%)	NA	NA	NA	NA	NA	NA	22
Calibration Error Analysis:									
Low-Range	112	14 (10%)	41	10 (21%)	18	9 (32%)	3	0 (0%)	15
Mid-Range	113	24 (17%)	36	15 (31%)	16	11 (39%)	3	0 (0%)	22
High-Range	97	40 (29%)	27	24 (50%)	14	13 (48%)	2	1 (50%)	35
OPERATING STATUS AUDIT RESULTS									
Fault Lamps	136	3 (2%)	48	0 (0%)	26	2 (7%)	3	0 (0%)	2
AGC Circuit	135	1 (<1%)	NA	NA	NA	NA	NA	NA	<1
Stack Exit Correlation Error	97	33 (24%)	34[b]	4 (8%)	22	6 (21%)	3	0 (0%)	22[b]
Panel Meter Status	31	88[a] (63%)	36	11 (23%)	22	5 (18%)	2	1 (50%)	54[a]
Reference Signal Error	130	3 (2%)	NA	NA	NA	NA	NA	NA	<1
Optical Dust Accumulation	105	23 (17%)	40	6 (13%)	22	3 (11%)	3	0 (0%)	16

[a] Lear Siegler panel meter readings of opacity were generally accurate, but values for optical density and circuit current were typically erroneous.

[b] Contraves Goerz internal OPLR and span values were not documented at seven facilities and error parameters could not be quantified for those systems.

[c] Specifications criteria for performance audit results are those found in 40 CFR 60, Appendix B, PS 1; for operating status results, the criteria are those specified by individual CEM manufacturers.

TABLE 2

CALIBRATION GAS AUDIT RESULTS
FOR SO_2 AND NO_x CEMS

	Lear Siegler Calibration Error		DuPont Calibration Error		Beckman Calibration Error		Bendix Calibration Error		% Total No. of Monitors Tested >15%
	<15%	>15%	<15%	>15%	<15%	>15%	<15%	>15%	
SO_2 GAS MONITOR CALIBRATION									
Number of Monitors Audited	9		3		1		1		
Low-Range	8	1	3	0	1	0	1	0	7
Mid-Range	7	2	3	0	1	0	1	0	14
High-Range	7	2	3	0	1	0	1	0	14
NO_x GAS MONITOR CALIBRATION									
Number of Monitors Audited	6		0		1		1		
Low-Range	4	2	NA	NA	1	0	1	0	25
Mid-Range	4	1	NA	NA	1	0	1	0	12
High-Range	6	0	NA	NA	1	0	1	0	0

TABLE 3

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION I						
New England Power & Service Company	Salem Harbor	1,2, 3	EDC 1100C	3	3/83	Salem, MA
New England Power & Service Company	South Street	121, 122	LSI RM7A	2	8/83	Providence, RI
REGION III						
West Penn Power Co.	Mitchell	3	Dynatron 1100	2	10/82	Courtney, PA
Getty Marketing & Refining Company	Delaware City	1,2, 3	LSI RM41	3	1/83	Delaware, DE
REGION IV						
Duke Power Company	Allen		LSI RM41	4	7/81	Belmont, NC
Carolina Power & Light	Sutton		LSI RM41	4	7/81	Wilmington, NC
Georgia Power Company	Plant McDonna	4,5	LSI RM41	1	9/81	Atlanta, GA
REGION V						
Commonwealth Edison	State Line		Contraves-400	2	5/81	Hammond, IN
Energy CO-OP	FCCU		LSI RM41	1	5/81	East Chicago, IN
Inland Steel	4AC Plant	401-404	LSI RM41	4	5/81	East Chicago, IN

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION V--Continued						
North Indiana Public Service	D.H. Mitchell	4/5, 6/11	LSI RM41	2	5/81	Gary, IN
ALCOA	Warrick	1-4	Contraves-400	3	5/81	Newburg, IN
Hoosier Energy	Petersburg	1,2	Contraves-400	2	5/81	Petersburg, IN
Indiana & Kentucky Gas and Electric	Clifty Creek	1-5	Dynatron 1100	2	5/81	Madison, IN
Dairyland Power Coop	J.P. Madgett	1	LSI RM41	1	12/83	Alma, WI
Wisconsin Electric Power Company	Oak Creek	7,8	Contraves-400	4	10/83	Oak Creek, WI
Wisconsin Electric Power Company	Pleasant Prairie	1	Contraves-400	1	10/83	Kenosha, WI
Wisconsin Power & Light Company	Columbia	2	Contraves-400	1	10/83	Portage, WI
Wisconsin Public Service Company	Weston	3	Contraves-400	1	10/83	Rothschild, WI
University of Wisconsin-Madison	Charter Street	1-5	Contraves-400	1	12/83	Madison, WI

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION V--Continued						
Central Illinois Light Company	Edwards	2	LSI RM41	1	12/83	Peoria, IL
A.E. Staley Company	Decatur	20	Dynatron 1100	1	12/83	Decatur, IL
Amoco Oil Company	FCCU	500	LSI RM41	2	12/83	Whiting, IL
Commonwealth Edison	Crawford	7,8	Contraves-400	2	11/81	Chicago, IL
Commonwealth Edison	Waukegan	6-8	LSI RM41	3	11/81	Waukegan, IL
Commonwealth Edison	Waukegan	6	LSI RM41	1	12/83	Waukegan, IL
Commonwealth Edison	Joliet	6-8	LSI RM41	3	11/81	Joliet, IL
Commonwealth Edison	Powerton	5,6	Contraves-400	1	11/81	Pekin, IL
Commonwealth Edison	Fisk	19	Contraves-400	1	11/81	Chicago, IL
Commonwealth Edison	Will County	2-4	Contraves-400	3	11/81	Joliet, IL
Commonwealth Edison	Will County	4	Contraves-400	1	12/83	Joliet, IL
Commonwealth Edison	Kincaid	1,2	Contraves-400	1	11/81	Kincaid, IL
Indianapolis Power & Light Company	Stout	60, 70	Durag D-R280AV (Teco)	2	7/82	Indianapolis, IN

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION V--Continued						
Rochester Public Util.	Silver Lake	1-4	Dynatron 1100	3	10/82	Rochester, MN
Rochester Public Util.	North Broadway	2,3	LSI RM41	1	10/82	Rochester, MN
Northern States Power	Riverside	6,7	LSI RM41	2	10/82	Minneapolis, MN
Northern States Power	Alan King	1	LSI RM41	1	10/82	Bayport, MN
Northern States Power	Black Dog	1-4	LSI RM41	1	10/82	Burnsville, MN
Potlatch Company		7,8, 9	LSI RM41	3	10/82	Cloquet, MN
Diamond International		1-4	LSI RM41	1	10/82	Cloquet, MN
Conwed Company		4	Dynatron 1100	1	10/82	Cloquet, MN
Blandin Paper Company		5,6	Contraves-400	2	10/82	Grand Rapids, MN
Ohio University			Contraves-400	1	7/82	Athens, OH
Ohio Power	Muskingum Riv.	5	LSI RM41	1	7/82	Beverly, OH
Ohio Power	Cardinal	1,2	Contraves-400	2	7/82	Brilliant, OH
Cleveland Electric Illuminating Company	Lakeshore	17, 18	Dynatron 1100	2	7/82	Cleveland, OH

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION V--Continued						
Cleveland Electric Illuminating Company	Eastlake	5A, 5B	Dynatron 1100	2	7/82	Cleveland, OH
Jones & Laughlin Steel Company	Cleveland Works	BOF	Dynatron 1100	2	7/82	Cleveland, OH
PPG Industries	Barberton	6,12	Dynatron 1100	2	7/82	Barberton, OH
Cincinnati Gas and Electric Company	Miami Fort	6	LSI RM41	1	7/82	North Bend, OH
Emery Industries		1	LSI RM41	1	7/82	Cincinnati, OH
Corning Glass Works	Greenville Plant	141, 142	Contraves-400	2	7/82	Greenville, OH
Ford Motor Company	Sharonville Transmission Plant	1,2	Contraves-400	2	7/82	Cincinnati, OH
Ford Motor Company	Cleveland Works	2	Contraves-400	1	7/82	Cleveland, OH
Ohio Edison	Sammis	7	Dynatron 1100	1	7/82	Straton, OH
Basic Refractories	Maple Grove Works	Lime Kiln	Dynatron 1100	2	8/82	Beltsville, OH

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION V--Continued						
Bowling Green State University	Heating Plant		Dynatron 1100	1	8/82	Bowling Green, OH
Toledo Edison	Acme	4,16	Dynatron 1100	2	8/82	Toledo, OH
Toledo Edison	Bayshore	1,2	Dynatron 1100	1	8/82	Toledo, OH
Detroit Edison Company	St. Clair	3	LSI RM41	1	9/83	St. Clair, MI
Detroit Edison Company	Marysville	11, 12	LSI RM41-11	1	9/83	Marysville, MI
Michigan State Univ.	Power Plant #65	1	LSI RM41	1	9/83	East Lansing, MI
Board of Water & Light	Eckert	4	Dynatron 1100	1	9/83	Lansing, MI
Consumers Power Co.	JC Weadock	7,8	Dynatron 1100	1	9/83	Essexville, MI
Consumers Power Co.	DE Karn	2	LSI RM4	2	9/83	Essexville, MI
Consumers Power Co.	Campbell	3	LSI RM41	2	9/83	West Olive, MI
Upper Peninsula Generating Company	Presque Isle	8	LSI RM41	1	9/83	Marquette, MI

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION VI						
Sun Refinery & Marketing Company	Tulsa Refinery	FCCU	LSI RM41	1	6/83	Tulsa, OK
Ford Motor Company	Tulsa Glass Plant		LSI RM41	2	6/83	Tulsa, OK
Murphy Oil Corporation	Meraux Refnry	42 FCCU	Dynatron 1100	1	6/83	Meraux, TX
Public Service Company of New Mexico	San Juan	1,2, 3,4	LSI RM41	4	7/83	Waterflow, NM
Houston Lighting & Power Company	W.A. Parish	7	Contraves-400	1	8/83	Thompson, TX
Gulf Refinery & Marketing Company	Port Arthur	FCCU 1241	LSI RM41	1	8/83	Port Arthur, TX
Arkansas Power & Light Company	White Bluff	1,2	LSI RM41	2	8/83	White Bluff, AR
REGION VII						
Omaha Public Power	North Omaha	1-5	Contraves-400	3	9/81	Omaha, NE
Fremont Dept. Util.	Fremont	1	LSI RM41	1	9/81	Fremont, NE

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION VII--Continued						
Iowa Public Services	George Neal	1,2	LSI RM41	2	9/81	Sioux City, IA
Cornbelt Power	Humboldt	1-4	Contraves-400	2	9/81	Humboldt, IA
Iowa Electric Light & Power	Boone	1	LSI RM41	1	9/81	Boone, IA
Iowa Electric Light & Power	Prairie Creek	1-4	LSI RM41	3	9/81	Cedar Rapids, IA
Iowa Sou Utility	Ottumwa	1	LSI RM41	1	9/81	Ottumwa, IA
Interstate Power	Lansing	3,4	LSI RM41	2	10/81	Lansing, IA
Independence Power & Light	Blue Valley	1-3	Dynatron 1100	3	10/81	Independence, MO
Missouri Public Serv.	Sibley	1-3	Contraves-400	1	10/81	Sibley, MO
St. Joseph Power & Light	Lake Road	5,6 (5)*	Contraves-400	2	10/81 (3/83)*	St. Joseph, MO
Kansas City Power & Light	Hawthorne	1,2, 5	LSI RM41	3	10/81	Kansas City, MO

* Parentheses indicate multiple audits.

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION VII--Continued						
Kansas City Power & Light	Quindera	1,2	Contraves-400	2	10/81	Kansas City, MO
Kansas City Power & Light	Iatan	1 (1)*	LSI RM41	1	10/81 (3/83)*	Weston, MO
Kansas City Power & Light	LaCygne	1	LSI RM41	1	10/81	LaCygne, KS
Columbia Water & Light	Columbia	6,7	Est An DR110B	1	10/81	Columbia, MO
Iowa-Illinois Gas & Electric	Riverside	7-9	Contraves-400	1	10/81	Bettendorf, IA
Nebraska Public Power Dist.	Sheldon	1,2	Est An DR28AU	2	11/81	Hallam, NE
Nebraska Public Power Dist.	Gerald G'man	1	LSI RM41	1	11/81	Sutherland, NE
Hastings Utility Dept.	Energy Center	1	LSI RM41	1	11/81	Hastings, NE
Iowa Power Company	Council Bluff	1-3	Contraves-400	3	11/81	Council Bluff, IA

* Parentheses indicate multiple audits.

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION VII--Continued						
Union Electric Power Company	Sioux	1,2 (1,2)*	LSI RM41	4	2/82 (3/83)*	West Alton, MO
Union Electric Power Company	Labadie	1-4	LSI RM41	8	3/82	Labadie, MO
Dundee Cement	Clarksville		Contraves-400	1	5/82	Clarksville, MO
St. Joseph Power & Light Company	Lake Road	5,6	Contraves-400	2	5/82	St. Joseph, MO
Missouri Portland Cement	Sugar Creek Kiln		Contraves-400	1	5/82	Sugar Creek, MO
River Cement Company	Festus Plant		Contraves-400	1	5/82	Festus, MO
Union Electric Power Company	Rush Island	1,2	LSI RM41	4	5/82	Festus, MO
Kansas City Power & Light	Montrose	2,3	LSI RM41	2	6/82	LaDue, MO
Empire District Cement Company	Asbury	1	LSI RM41	1	6/82	Joplin, MO

* Parentheses indicate multiple audits.

TABLE 3--Continued

OPACITY MONITOR PERFORMANCE AUDITS CONDUCTED
MAY 25, 1984

Company	Station	Unit	Monitor Type	No. of Monitors	Date	Location
REGION VII--Continued						
City Utility of Springfield	James River	4,5	Dynatron	2	4/83	Springfield, MO
REGION VIII						
U.S. Steel	Geneva Works	2	Dynatron 1100	1	9/82	Provo, UT
U.S. Steel	Geneva Works	OHS	Prototype LSI	1	9/82	Provo, UT
REGION X						
Columbia Cement		1,2	Dynatron 1100	2	6/80	Bellingham, WA
St. Regis Paper Mill	Seattle	3	LSI RM4	1	7/83	Seattle, WA
Ideal Cement Company			LSI RM4	1	7/83	Tacoma, WA

TABLE 4

CALIBRATION ERROR PERFORMANCE AUDITS CONDUCTED
FOR SO_2 AND NO_x CEMS

Company	Station	Unit	Monitor Type	No. of Monitors	Parameter Audited	Date	Location
Austell Box Board Company	Austell	---	LSI SM810	1	$SO_2/NO_x/O_2$	11/83	Austell, CA
City of Lakeland	McIntosh	3	LSI SM810	1	SO_2/NO_x	8/83	Lakeland, FL
St. Regis Paper Company	Cantonment Mill	4	LSI SM810	1	SO_2/NO_x	8/83	Cantonment, FL
Big Rivers Electric Corporation	Green	1,2	LSI SM810	2	SO_2/NO_x	6/83	Henderson, KY
TVA	Bull Run	1A,1B	LSI SM810	2	SO_2/NO_x	5/83	Knoxville, TN
TVA	Colbert	1-4	LSI SM810	1	SO_2/NO_x	11/83	Tuscumbia, AL
South Mississippi Power Association	RD Morron	2	LSI SM810	1	SO_2/NO_x	11/83	Purvis, MS
Carolina Power & Light Company	Roxboro	4	LSI SM810	1	NO_x	10/83	Roxboro, NC
Farmland Industries	-----	---	DuPont 460	1	SO_2	8/83	Bartow, MS
Alabama Electric Coop	Tombigbee	2,3	DuPont 460	1	SO_2	11/83	Leroy, AL
Texas Chemical Company	Aurora	---	DuPont 460	1	SO_2	10/83	Aurora, NC
Trademark Nitrogen	-----	---	Beckman 951	1	NO_x	8/83	Tampa, FL
Public Service Company of South Carolina	Wynha	3	Bendix	1	SO_2/NO_x	10/83	Georgetown, SC

TABLE 5

RELATIVE ACCURACY PERFORMANCE AUDITS
CONDUCTED FOR SO_2 AND NO_x CEMS

Company	Station	Unit	Monitor Type	Parameters	Date	Location
REGION I						
Boise Cascade	-----	Recovery Boiler C	LSI SM810	SO_2/O_2	10/82	Rumford, ME
Central Maine Power	Wyman	4	EDC-DIGI-1400	NO/CO_2	10/82	Yarmouth, ME
REGION III						
Arco Polymers	Beaver Valley	3	DuPont 400/ Thermox O_2	SO_2/O_2	1/81 11/81 4/82 11/82 4/83 7/83	Monaca, PA
Philadelphia Electric Company	Cromby	1	Contraves GEM-100	$SO_2/NO/CO_2$	4/83	Phoenixville, PA
Virginia Electric and Power Company	Possum Point	4	DuPont 400/ Thermox O_2	SO_2/O_2	1/82 3/82	Dumfries, VA
Virginia Electric and Power Company	Possum Point	4	CSI Prototype/ Thermox O_2	SO_2/O_2	1/82 3/82	Dumfries, VA
REGION IV						
Carolina Eastman Company	-----	3,4	LSI SM810/CM50	$SO_2/NO/O_2$	10/77 10/78 12/79	Columbia, SC

TABLE 5--Continued

RELATIVE ACCURACY PERFORMANCE AUDITS
CONDUCTED FOR SO_2 AND NO_x CEMS

Company	Station	Unit	Monitor Type	Parameters	Date	Location
REGION IV--Continued						
South Mississippi Power Association	RD Morrow	1	LSI SM810/CM50	$SO_2/NO/O_2$	7/81 12/81 5/82 11/82 2/83 5/83 8/83	Purvis, MS
South Mississippi Power Association	RD Morrow	2	LSI SM810/CM50	$SO_2/NO/O_2$	5/81 7/81 12/81 4/82 11/82 2/83 5/83 8/83	Purvis, MS
REGION V						
Commonwealth Edison	Collins	1-3	EDC-DIGI-1400	NO/CO_2	7/80	Morris, IL
Commonwealth Edison	Collins	4,5	EDC-DIGI-1400	NO_x/CO	7/80	Morris, IL
Central Illinois Public Service	Newton	1	Contraves GEM-1	SO_2/CO_2	9/80 7/81 12/81 3/82 6/82 9/82	Newton, IL

TABLE 5--Continued

RELATIVE ACCURACY PERFORMANCE AUDITS
CONDUCTED FOR SO_2 AND NO_x CEMS

Company	Station	Unit	Monitor Type	Parameters	Date	Location
REGION V--Continued						
Indianapolis Power and Light	Petersburg	3	EDC-DIGI-1400	SO_2/CO_2	7/81	Petersburg, IN
Hamiltion Department of Public Service	Hamilton Generating Station	9	LSI SM810/CM50	SO_2/O_2	9/81	Hamilton, OH
Blandin Paper Company	-----	5,6	Contraves GEM-1	SO_2/CO_2	9/82	Grand Rapids, MN
Potlatch Company	-----	9	LSI SM810/CM50	SO_2/O_2	9/82	Cloquet, MN
Upper Peninsula	Presque Isle	8	LSI SM810/CM50	SO_2/O_2	4/83 9/83	Marquette, MI
Detroit Edison	Monroe	3,4	Contraves GEM-100	SO_2/CO_2	9/83	Monroe, MI
Wolverine Power	Advance Steam Plant	3	Contraves GEM-100	SO_2/CO_2	9/83	Advance, MI
REGION VI						
Oklahoma Gas and Electric	Muskogee	5	LSI SM810/CM50	$SO_2/NO/O_2$	10/80	Muskogee, OK
Houston Power and Light	W.A. Parrish	8	KVB	$SO_2/NO_x/CO_2$	8/83	Thompsons, TX

TABLE 5--Continued

RELATIVE ACCURACY PERFORMANCE AUDITS
CONDUCTED FOR SO_2 AND NO_x CEMS

Company	Station	Unit	Monitor Type	Parameters	Date	Location
REGION VII						
Iowa Power	Council Bluffs	3	EDC-DIGI-1400	SO_2/CO_2	12/81	Council Bluffs, IA
Interstate Power	Lansing	4	LSI SM810/CM50	SO_2/O_2	12/81	Lansing, IA
Nebraska Public Power	Gerald G'man	1	LSI SM810/CM50	$SO_2/NO/O_2$	12/81	Sutherland, NE
Union Electric Power	Sioux	2	DuPont 460/ LSI CM50	SO_2/O_2	2/82	W. Alton, MO
Union Electric Power	Labadie	2	LSI SM810/CM50	SO_2/O_2	2/82	Labadie, MO
Union Electric Power	Labadie	3	LSI SM810/CM50	SO_2/O_2	3/82	Labadie, MO
Union Electric Power	Labadie	1	LSI SM810/CM50	SO_2/O_2	3/82	Labadie, MO

TABLE 6

RELATIVE ACCURACY TEST RESULTS FOR SO_2 CEM PERFORMANCE AUDITS CONDUCTED AFTER SUCCESSFUL PERFORMANCE SPECIFICATION TESTS (PSTs)

MONITOR TYPE	FGD	ELAPSED TIME SINCE PST (MONTHS) 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
1. L S I	YES	PASS PASS PASS PASS PASS PASS PASS PASS PASS
2. L S I	YES	PASS PASS PASS FAIL FAIL PASS PASS
3. DuPONT	YES	PASS PASS PASS PASS PASS
4. CONTRAVES	YES	PASS PASS FAIL FAIL FAIL FAIL
5. E D C	YES	PASS PASS
6. CONTRAVES	YES	PASS PASS
7. K V B	YES	PASS PASS
8. L S I	NO	PASS PASS PASS
9. DuPONT	NO	PASS PASS
10. C S I	NO	PASS PASS
11. L S I	NO	PASS PASS
12. L S I	NO	PASS PASS
13. E D C	NO	PASS FAIL
14. L S I	NO	PASS PASS
15. L S I	NO	PASS PASS
16. L S I	NO	PASS PASS
17. L S I	NO	PASS PASS
18. DuPONT	NO	PASS PASS
19. L S I	NO	PASS PASS
20. L S I	NO	PASS PASS
21. CONTRAVES	NO	PASS FAIL
22. CONTRAVES	NO	PASS PASS
23. L S I	NO	PASS FAIL
24. CONTRAVES	NO	PASS PASS
25. CONTRAVES	NO	PASS PASS

TABLE 7

RELATIVE ACCURACY TEST RESULTS FOR NO_x CEM PERFORMANCE AUDITS
CONDUCTED AFTER SUCCESSFUL PERFORMANCE SPECIFICATION TESTS (PSTs)

MONITOR TYPE	FGD	ELAPSED TIME SINCE PST (MONTHS) 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
1. L S I	YES	PASS PASS PASS FAIL PASS PASS PASS PASS
2. L S I	YES	PASS PASS PASS PASS PASS FAIL PASS
3. L S I	NO	PASS FAIL FAIL
4. L S I	NO	PASS PASS
5. E D C	NO	PASS PASS
6. E D C	NO	PASS PASS
7. L S I	NO	PASS FAIL
8. E D C	NO	PASS FAIL